Original Research

Transitions in Hearing Impairment and Psychological Distress in Older Adults

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Objective: Although previous research has demonstrated an association between hearing impairment (HI) and psychological distress, less work has explored the effect of transitions in hearing status on distress over time, or the explanatory pathways that may explain this association.

Method: We use 2 waves of data from the Canadian National Population Health Survey to examine the effect of HI transitions on changes in distress during 6 years, and to test the potential mediating effects of psychosocial factors and chronic stressors.

Results: Experiencing a decline in hearing was associated with increased distress at Wave 4, net of Wave 1 distress, although the significance of the relation was reduced to trend level following adjustment for sociodemographic variables ($P < 0.06$). The introduction of mastery and self-esteem further reduced the size of the effect of reporting a decline in hearing in the full model.

Conclusions: The association between declines in HI and psychological distress during a 6-year period did not reach a traditional level of statistical significance, and we discuss potential explanations for this finding. Mastery and self-esteem may be important explanatory variables in the HI–distress association and should be considered in future research.

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Clinical Implications

- HI among older adults is not a static condition, and negative changes, or declines in hearing, are associated with psychological distress. Negative changes in hearing may signal the need for practitioners to explore mental health issues with their patients.
- HI has the potential to erode important psychosocial resources, such as mastery and self-esteem, which, in turn, are associated with psychological distress. Interventions to address changes in control and self-worth that accompany hearing loss, in conjunction with assistive devices (for example, hearing aids), may reduce the impact of HI on psychological well-being.
- It is important to address HI periodically with patients, and to consider the impact of changes in HI on psychological well-being.

Limitations

- Our measure of HI is based on self-report and may underestimate the prevalence of hearing problems among older adults. Conversely, respondents with elevated levels of psychological distress may be more likely to report a chronic condition such as HI.
- Our data did not include measures that address the psychosocial impact of HI specifically, and thus we rely on more global measures of mastery, self-esteem, and chronic stressors. Further research with hearing-specific measures is needed to fully address the impact of HI on psychological well-being.
- Our data were collected using telephone interviews, and respondents with hearing problems might have been less likely to participate. Statistics Canada did not document the use of any assistive devices among respondents with HI, which may permit respondents to converse normally on the telephone.

Key Words: *hearing impairment, psychological distress, stress process*

HI is a common chronic condition among older adults, affecting about 3 million people in the general Canadian population.[1,2] Most HI in older adults is sensorineural, making it difficult to filter out background noise in busy or social settings.[3] As such, HI may have a deleterious effect on psychological well-being because it can have a profound effect on social functioning and interpersonal relationships.[4–6]

Previous work has identified an association between HI and depression among older adults using cross-sectional data.[7–10] However, HI is not a static state and greater attention must be paid to the potential changes in HI status over time, and its effects on psychological distress. For example, the use of a hearing aid could greatly improve a person's quality of life, functioning, and quality of interpersonal relationships,[11,12] which, in turn, may be beneficial for mental health. Further, while cross-sectional work has identified a negative association between HI and psychosocial resources,[8] the potential for these resources to mediate the HI–distress association has not been examined.

The stress process model provides a useful framework for conceptualizing how transitions in HI may be linked with psychological outcomes.[13,14] The stress process model is composed of 3 central domains: stressors, stress mediators (such as psychosocial resources), and stress-related outcomes (psychological distress). The model is used to better understand the conditions under which stress leads to negative health outcomes, such as a psychological distress or symptoms of depression, and has been widely used in the area of stress research. Within this framework, declines in hearing are considered to be primary stressors, and may exert both direct and indirect influences on psychological distress. Previous work in stress process research has used measures of chronic health problems as indices of chronic stress.[15] Changes in one's ability to hear may necessitate numerous changes in behaviour and attitudes that are stress-provoking, giving rise to secondary stressors in other life domains such as interpersonal conflict with significant others, which then exact a toll on psychological well-being. Potential stress mediators, such as mastery and self-esteem, may explain or account for part of the relation between a stressor (such as HI) and distress. Mastery, or the extent to which people feel in control and that the things they do make a difference, is regarded as being particularly important for both physical and mental well-being among older adults. Erosion of these personal resources as a result of HI may mediate or partially explain the association between changes in HI and psychological distress. Indeed, cross-sectional research has shown that HI is positively related with negative self-perceptions and lower personal control,[8,16,17] both of which may account for the association between negative changes in hearing status (onset of hearing problems, or moving from corrected to uncorrected HI) and psychological distress. People with HI may feel less confident, independent, or in control of their environment, which, in turn, leads to greater psychological distress.

While previous research on the implications of HI in later life considered the impact on psychosocial resources, they were considered as outcomes rather than explanatory mechanisms or mediators of the HI–distress association.[8] In fact, to our knowledge, no research has looked at the impact of changes in self-reported HI on psychological distress over time. In our study, we examine the effect of changes in HI on the psychological well-being of older adults during a 6-year period, and test the mediational pathways that may account for this association.

Abbreviations used in this article

HI	hearing impairment
NPHS	National Population Health Survey

Method

Sample

We used 2 waves of data from the NPHS, a biennial survey of a national probability sample of all Canadian residents.[18] In 1994, using a multistaged stratified, random sampling procedure, 19 600 households were surveyed in which one person from each household provided detailed personal information. Among the 18 342 possible respondents, 17 262 were interviewed (96.1% response rate). We selected only respondents who were aged 50 years or older at Wave 1 (n = 5404). Between Waves 1 and 4, about 16% of our sample died, 3% were institutionalized, and 10% were lost to follow-up. Additional respondents were lost owing to missing information on key variables, providing us with a sample size of 3113. Waves 2 and 3 were not used as they did not include the mastery and self-esteem measures. The NPHS used a multistage, stratified cluster design to select eligible households. Owing to the complexity of the sampling design, Statistics Canada recommends bootstrapping of all tests using a set of replicate weights that they supply. Bootstrapping is a re-sampling technique used to generate valid estimates of variance, which may be underestimated because of the cluster sampling methodology. All results presented here were produced with this approach. Stata software[19] was used to bootstrap all results. Data for this study were obtained from the Master Files of the NPHS maintained at the Statistics Canada Research Data Centre, Toronto.

Dependent Variable

Psychological distress was assessed using 6 items from a measure of generalized distress.[20] Respondents were asked: "During the past month, how often did you feel: (1) so sad nothing could cheer you up (2) nervous (3) restless or fidgety (4) hopeless (5) worthless (6) that everything was an effort?" Respondents answered each query using a 5-point response set, ranging from "All of the time" to "None of the time" (Cronbach's $\alpha = 0.79$). Higher scores indicated greater psychological distress.

Independent Variables

The independent variables are described in Table 1. The data included 5 questions about HI from the Health Utility Index,[21] which were used to construct HI status variables for Waves 1 and 4, and to construct the HI transition variable. Respondents who indicated they could not hear at all ($n = 18$) were excluded from these analyses, as it is unclear how they could have participated in the telephone interview, further reducing the sample size to 3095. Studies comparing self-rated HI to pure tone audiometric testing reported good specificity and sensitivity for HI and concluded that self-rated HI is a valid measure for estimating HI in the population.[22,23] In this analysis, we consider the influence of mastery,[24] self-esteem,[25,26] and chronic stressors[27] as potential explanatory pathways linking transitions in HI to psychological distress. We also adjust the models for age, sex, marital status, education, and the presence of chronic health conditions.

Analysis

We first estimated the prevalence of the transition groups: stable no HI, stable HI (corrected or uncorrected), decline, and improvement. We then tested whether change in distress during the 6-year period was associated with HI transitions (the reference category was stable no HI) using the residualizing technique described by Kessler and Greenberg.[28] This involved regressing distress at Wave 4 on Wave 1 distress, as well as Wave 1and Wave 4 predictors. The effects of the Wave 1 predictors can be interpreted as the baseline effect on change in distress, while Wave 4 coefficients assess the change in the predictor variable on change in distress. To assess the potential mediating effects of mastery, self-esteem, and chronic stressors, we entered both Wave 1 and 4 measures to assess the extent to which they attenuated the effect of the HI transitions on distress. As such, evidence of meditational effects will be contingent on observing a reduction in the effect of the HI transition variables on changes in psychological distress. In the final model (Model 6), we adjusted for the effect of changes in chronic health problems to rule out the possibility of a spurious association between HI and psychological distress.[29] We elected to use a negative binomial regression model, owing to the discrete and skewed distribution of the outcome variable. The negative binomial is similar to Poisson regression, but demonstrated a better model fit.[30] As the dependent variable is logged, the coefficients can be interpreted similarly to those from a logistic regression analysis. For example, calculating $100(e^{\beta} - 1)$ indicates the percentage change in the dependent variable for a 1-unit change in the independent variable.

Results

The mean age of the sample at Wave 1 was 61.8 years, and 58% of the sample was female. The majority of respondents were married at Wave 1 (72.3%), 22.5% were never married, and 5.2% previously married. For transitions, 89.2% (95% CI 87.8 to 90.5) of respondents experienced no hearing problems (stable no HI), 2.5% (95% CI 1.9 to 3.2) were stable HI, 4.4% (95% CI 2.3 to 5.2) reported a decline, and 4.0% (95% CI 3.0 to 4.9) reported an improvement in their HI status. The means of other key variables of interest are presented in Table 2. Table 3 presents the regression analysis. In Model 1, psychological distress at Wave 1 was a significant predictor of distress 6 years later. The coefficients for the HI transition variables represent their association with changes in psychological distress at Wave 4, net of the effect of distress at Wave 1. Experiencing a decline in hearing was the only HI transition significantly associated with changes in distress. Compared with the stable no HI group, respondents who reported a decline had distress scores that were 27% higher. Following the adjustment for sociodemographic measures in Model 2, the coefficient for the decline group did not change but was only significant at trend level ($P < 0.06$). It is important to note that the effect of experiencing a decline in hearing on distress was statistically significant ($P < 0.05$) in Model 2 when we applied the standardized population weights provided by Statistics Canada for the longitudinal file of the NPHS (not shown). However, following the application of the bootstrap weights, the significant effect of experiencing a decline in hearing on psychological distress was reduced. While we may typically be skeptical of marginal effects in large datasets, the application of the bootstrap weights is a procedure that reduces the likelihood of finding significant effects by increasing variance estimates. Moreover, these data provided an opportunity to investigate potential explanatory pathways in the HI–distress association reported in previous research (see Discussion). For these reasons, we decided to proceed and introduce the remaining variables in the analysis; psychosocial resources (mastery and self-esteem) and chronic stressors were entered in Models 3 and 4, respectively, to test for potential mediating or suppression effects. Meditational effects of mastery and self-esteem were evident in Model 3, reducing the coefficient for the decline in HI group by 38% from Model 2 (from 0.24 to 0.15). This suggested that changes in mastery and

Table 1 Description of independent variables

Variable	Description
HI Original items from the Health Utility Index 1. Without a hearing aid, are you usually able to hear what is said in a group conversation with at least 3 other people? 2. If no, with a hearing aid, are you usually able to hear what is said in a group conversation with at least 3 other people? 3. Are you able to hear at all? 4. Without a hearing aid, are you usually able to hear what is said in a conversation with one other person in a quiet room? 5. With a hearing aid, are you usually able to hear what is said in a conversation with one other person in a quiet room? Response format: yes, no, or n/a	Recoded HI measure (Waves 1 and 4) 1. No HI: reported no difficulties hearing 2. Corrected HI: reported all identified hearing problems as corrected 3. Uncorrected HI: reported any identified hearing problem as uncorrected (even if one aspect of hearing impairment was corrected) 4. Cannot hear at all: answered no to Question 3—these respondents were removed HI transitions (between Waves 1 and 4) 1. Stable HI—respondents who reported corrected or uncorrected HI at both waves 2. Decline—respondents who reported a decline in hearing over time (no HI at Wave 1 to corrected or uncorrected HI at Wave 4, or corrected HI at Wave 1 to uncorrected HI at Wave 4) 3. Improve—respondents who reported an improvement in hearing (corrected or uncorrected HI at Wave 1 to no HI at Wave 4, or uncorrected HI at Wave 1 to corrected HI at Wave 4) 4. Stable no HI—respondents who reported no HI at both waves (reference category)
Mastery	Refers to the extent to which people view themselves to be in control of their lives.[22] Respondents were asked how strongly they agreed or disagreed with each of 7 items on a 5-point scale (α = 0.76), with higher scores indicating greater mastery.
Self-esteem	Refers to one's personal sense of worth. Respondents were asked to indicate agreement or disagreement with 6 items on a 5-point scale from Rosenberg's original 10-item measure. Higher scores indicated greater self-esteem (α = 0.85).
Chronic stressors	Respondents were asked about the occurrence of 17 possible chronic stressors, which was adjusted and standardized to account for the number of applicable situations (for example, respondents who were married or who had children answered more questions than others). Higher scores indicated greater stress.
Chronic health conditions	Respondents were asked: "Do you have diabetes (asthma, arthritis, heart disease, high blood pressure, chronic bronchitis, stomach ulcers, effects of stroke, migraine headaches, urinary incontinence) diagnosed by a health professional?" An index was created summing yes responses to each health condition (0 to 12).
Age, years	55 to 102
Sex	We compared females with males (female = 1, male = 0)
Marital status	Previously married (separated, divorced, or widowed) and single respondents are compared with married (including common-law) respondents.
Education	An 8-category ordinal variable ranging from no formal education to the completion of a graduate or professional degree. A higher score indicated a higher level of education.

n/a = not applicable

Table 2 Longitudinal sample characteristics (*n* = 3095)

Variable	Mean (95% CI)
Distress, Wave 1	2.7 (2.5–2.8)
Distress, Wave 4	2.0 (1.8–2.1)
Mastery, Wave 1	19.4 (19.2–19.6)
Mastery, Wave 4	19.2 (19.0–19.4)
Self-esteem, Wave 1	20.4 (20.2–20.5)
Self-esteem, Wave 4	19.3 (19.1–19.4)
Chronic stressors, Wave 1	2.4 (2.3–2.5)
Chronic stressors, Wave 4	1.8 (1.7–1.9)
Chronic health, Wave 1	1.07 (1.0–1.1)
Chronic health, Wave 4	1.43 (1.36–1.49)

self-esteem partially accounted for the association between declines in HI and distress. A similar mediating effect of changes in chronic stressors in Model 4 was not evident, although changes in chronic stressors were significantly and positively associated with changes in distress, net of their baseline effect on distress. In Model 5, we included all potential mediators, simultaneously, and the coefficient for decline in HI was reduced by 42% from Model 2. In Model 6, we adjusted for the effect of changes in chronic health conditions on changes in distress, which were significantly related to distress; however, their inclusion had little impact on the coefficients representing HI transitions. Sex (female) was positively and significantly associated with changes in distress across all models, and age and being previously married were significantly associated with changes in distress only in Model 4, where we tested for the potential mediating effect of changes in chronic stressors. There was no consistent effect of education across models.

Discussion

In our study, we examined the association between transitions in HI and psychological distress over time in a nationally representative sample of Canadians aged 50 years and older. People who reported a decline in hearing during the 6-year period reported greater distress (at trend level only, $P < 0.06$) at Wave 4, compared with respondents who reported no hearing problems at both waves, even after adjusting for the effect of Wave 1 distress. The nonsignificant effect between experiencing a decline in HI and distress over time may be attributable to sample attrition during the 6-year period. As discussed earlier, 16% of the sample died and 3% were institutionalized between Waves 1 and 4. It is probable that these respondents were generally in poorer health, and more likely to report chronic conditions such as HI. As such, the relation between declines in HI and distress in our sample may be underestimated. Moreover, in other samples where a significant effect of HI on psychological distress or depression is reported, the independent variable has been either a dichotomous measure of the presence of hearing loss[8,10] or a trichotomous variable distinguishing no HI from mild or moderate HI.[5] These measures differ from the independent variable of interest in our work—transitions in HI over time. Thus our focus on stability and change over time, compared with reported states, may also partly explain the nonsignificant effect reported here following adjustment for key sociodemographic measures.

While the adjusted association between HI and psychological distress in our study did not reach statistical significance ($P < 0.6$), the evidence for an association between HI and psychological well-being in the extant literature suggested that an exploration of the potential pathways in this relation was important nonetheless.[5,8–10] None of the aforementioned studies have assessed the potential explanatory pathways that might account for this association, and the association between decline in hearing status and distress was at least trending to significant. However, conclusions drawn from these findings must be viewed very cautiously given that the association between HI and distress failed to reach the traditionally accepted level of statistical significance.

With that in mind, changes in mastery and self-esteem had the greatest impact on the association between declines in hearing and psychological distress. The reduction in the decline coefficient following the inclusion of mastery and self-esteem suggests that mastery and self-esteem may be 2 important resources that are compromised with hearing loss, which, in turn, is associated with greater distress. Indeed, previous longitudinal work has demonstrated how stressors can negatively influence a person's self-worth and sense of personal control.[13,31] From a clinical perspective, this finding highlights the importance of maintaining or bolstering feelings of control among people who experience declines in HI. Indeed, an important part of the negative effect of HI is through feelings of loss of control. As such, learning to cope with HI will involve finding solutions to offset the interference to normal activities of daily living, such as social interactions, that accompany hearing loss. The use of assistive devices for improving HI may be especially important in this regard. Further work should explore the role of mastery and self-esteem in this process.

The unadjusted effect of declines in HI on distress resonates with previous cross-sectional work that reports higher levels of psychological distress and depression among people with HI,[7–10,32,33] but extends these findings by looking at HI transitions and changes in distress over time. Respondents who reported stable corrected or uncorrected HI over time did not report significantly greater distress, supporting the

Table 3 Negative binomial regression of psychological distress on transitions in HI

	Model					
Variable	1	2	3	4	5	6
Distress, Wave 1	0.13[a] (0.01)	0.13[a] (0.01)	0.10[a] (0.01)	0.11[a] (0.01)	0.10[a] (0.01)	0.08[a] (0.01)
HI:						
Stable	–0.08 (0.19)	–0.06 (0.19)	–0.06 (0.17)	–0.04 (0.18)	–0.05 (0.17)	–0.06 (0.17)
Decline	0.24[b] (0.15)	0.24[c] (0.16)	0.15 (0.13)	0.22 (0.15)	0.14 (0.13)	0.14 (0.12)
Improvement	0.22 (0.17)	0.20 (0.18)	0.13 (0.15)	0.25 (0.20)	0.17 (0.16)	0.17 (0.16)
Mastery, Wave 1			–0.002 (0.01)		0.0004 (0.01)	–0.001 (0.01)
Mastery, Wave 4			–0.12[a] (0.01)		–0.10[a] (0.01)	–0.09[a] (0.01)
Self-esteem, Wave 1			0.01 (0.01)		0.01 (0.01)	0.004 (0.01)
Self-esteem, Wave 4			–0.02 (0.01)		–0.03 (0.01)	–0.03 (0.01)
Chronic stressors, Wave 1				–0.01 (0.01)	–0.01 (0.01)	–0.01 (0.01)
Chronic stressors, Wave 4				0.17[a] (0.02)	0.11[a] (0.02)	0.10[a] (0.02)
Age, years		0.002 (0.004)	0.001[b] (0.003)	0.01[d] (0.004)	0.01 (0.003)	0.01 (0.003)
Female		0.19[b] (0.09)	0.19[d] (0.08)	0.15[b] (0.08)	0.17[b] (0.08)	0.16[b] (0.08)
Single		–0.03 (0.18)	–0.05 (0.14)	–0.09 (0.14)	–0.08 (0.13)	–0.08 (0.13)
Previously married		–0.11 (0.06)	–0.06 (0.06)	–0.18[d] (0.06)	–0.12 (0.06)	–0.11 (0.06)
Education		–0.05[b] (0.02)	–0.01 (0.02)	–0.05[b] (0.02)	–0.02 (0.02)	–0.01 (0.02)
Chronic health, Wave 1						–0.05 (0.03)
Chronic health, Wave 4						0.09[a] (0.03)
Deviance	3360.18	3361.69	3465.76	3394.5	3485.45	3493.33

[a] $P < 0.001$; [b] $P < 0.05$; [c] $P < 0.10$; [d] $P < 0.01$

Standard errors reported in parentheses

hypothesis that there may be a psychological adaptation to chronic disorders such as hearing loss.[34] This is also partially supported by the coefficients for improvement in hearing, which, while not significant, were not entirely dissimilar from those for the decline group. As research on HI has traditionally compared HI states rather than transitions, further research into the effects of transitions in HI over time merits investigation.

Our findings also suggest that while changes in chronic stressors were positively and significantly associated with distress over time, they are independent of the association between HI transitions and psychological distress. It may be that the secondary strains associated with HI are most importantly manifested in difficulties with personal relationships and the inability to participate in social functions—dimensions that were not adequately captured in our measure of chronic stress. Additional work with more refined measures of chronic stress related to interpersonal relationships and personal health would help to further our understanding of the link between uncorrected HI and stressors in other domains.

These findings should be considered in the context of the following limitations. First, while secondary data provides a large, representative sample, we were limited by the available measures. For example, the measure of social support was not consistent across waves, which inhibited an analysis of changes in social support with changes in HI. Further, a measure such as the Hearing Handicap Inventory for the Elderly, which assesses the emotional and social impact of HI, may better tap into the psychosocial consequences of transitions in HI and its subsequent impact on psychological well-being.[35] As the data for all variables were self-reported, we must also consider the possibility of recall bias. It is also possible that elevated levels of psychological distress might have increased the likelihood of reporting a chronic condition such as HI. Lastly, because the data were collected through telephone interviews, people with HI may be less likely to participate, and thus may be underrepresented in this sample. Statistics Canada does not specifically document whether or how people with HI were able to complete telephone interviews. However, it is possible that these respondents had access to assistive devices, such as an amplified

telephone, which allow them to converse normally over the phone.

Conclusions

Notwithstanding these limitations, we were able to examine the impact of transitions in HI on psychological distress over time, as well as test some of the explanatory pathways in the context of the stress process model. To our knowledge, this is the first study to test multiple pathways between HI and psychological distress using the theoretical framework of the stress process model. Future work with measures specific to the psychosocial effects of HI, as well as a clinical measure of hearing, is necessary to further elucidate the association between transitions in hearing, psychosocial resources, and psychological distress over time.

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Résumé : Les transitions de la déficience auditive et la détresse psychologique chez les adultes âgés

Objectif : Bien que la recherche antérieure ait démontré une association entre la déficience auditive (DA) et la détresse psychologique, moins d'études ont exploré l'effet des transitions de l'état de l'ouïe sur la détresse avec le temps, ou les mécanismes explicatifs qui peuvent faire comprendre cette association.

Méthode : Nous utilisons 2 cycles de données de l'Enquête nationale sur la santé de la population pour examiner l'effet des transitions de DA sur les changements de détresse pendant 6 ans, et pour vérifier les effets médiateurs potentiels des facteurs psychosociaux et des stresseurs chroniques.

Résultats : Subir un déclin de l'ouïe était associé avec une détresse accrue au cycle 4, déduction faite de la détresse du cycle 1, bien que la signification de la relation ait été réduite au niveau d'une tendance après ajustement des variables sociodémographiques ($P < 0,06$). L'introduction de la maîtrise et de l'estime de soi a réduit encore plus la taille de l'effet de déclarer un déclin de l'ouïe dans le modèle complet.

Conclusions : L'association entre les déclins de DA et la détresse psychologique durant une période de 6 ans n'a pas atteint le niveau classique de signification statistique, et nous discutons d'explications potentielles de ce résultat. La maîtrise et l'estime de soi peuvent être d'importantes variables explicatives de l'association entre DA et détresse, et devraient être prises en compte dans la future recherche.